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The Effects Of Environmental Conditions On The Strength Of Double Lap Joints

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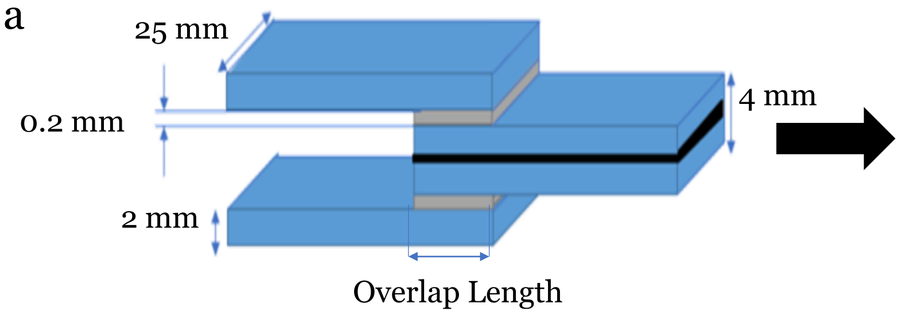
The strength of double lap joints for increasing overlap lengths at Room Temperature Dry (RTD), Hot Temperature Dry (HTD) and Hot Temperature Wet (HTW) conditions was studied. The failure mechanisms were identified and material characterisation tests were conducted to understand the joint performance and changing failure modes.

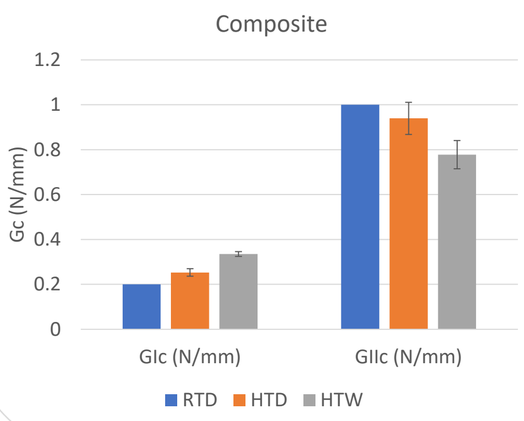
Specimen Configuration

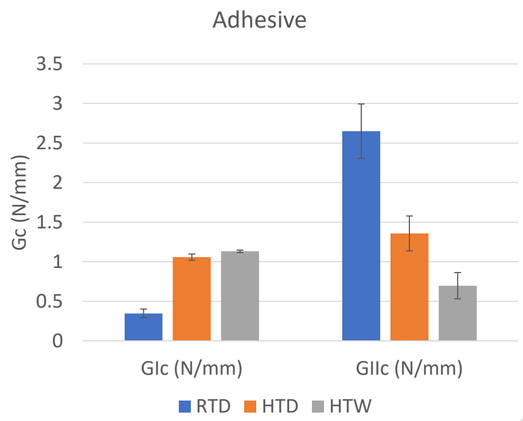
- **Adherends:** Hexcel HexPly® IM7/8552 carbon/epoxy pre-pregs with a stacking sequence of $[0/45/90/-45]_{ns}$
- **Adhesive**: Hexcel Redux® 319 film adhesive
- **Secondary Bonding**
- **Surface Preparation:** Grit-blasting (1.8 µm) and Liquid Degreasing
- Two overlap lengths of **12 mm** and **36 mm** tested



Material Characterisation

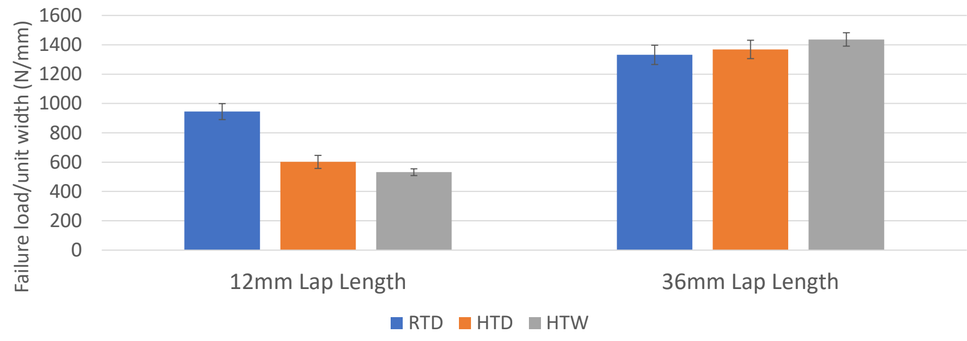
- **Significant strength reduction** for both adhesive and composite due to temperature and moisture
- **GIC increases** with temperature and moisture while **GIIC decreases** for both adhesive and composite using DCB and ENF tests respectively





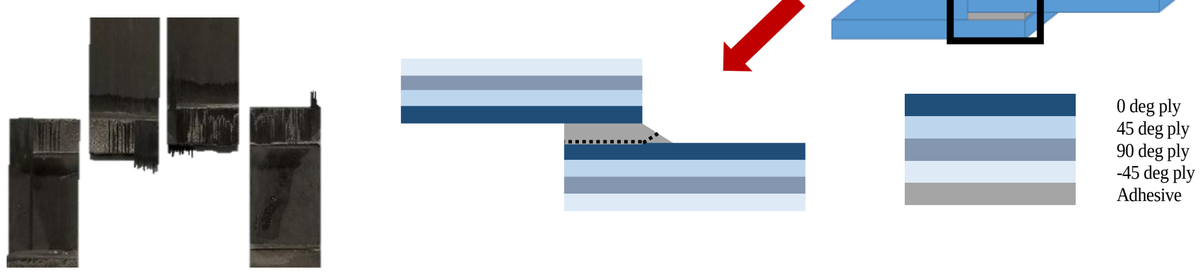
Double Lap Joint Results

- **12 mm overlap length:** Significant decrease in failure load as the failure was controlled by the shear strength
- **36 mm overlap length:** No significant difference in strength **-** Fracture dominated for all conditions – GIC increases and GIIC decreases

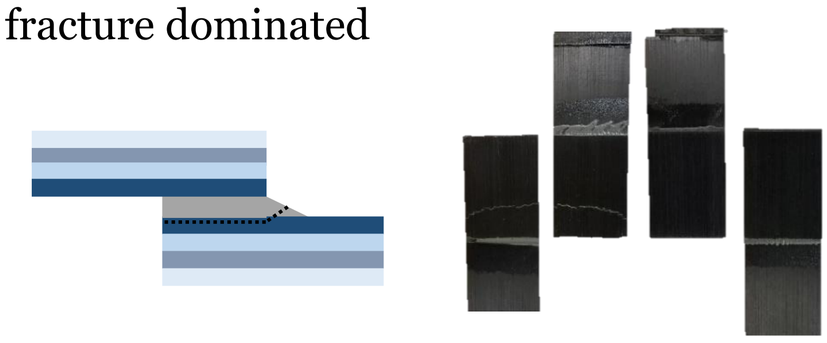


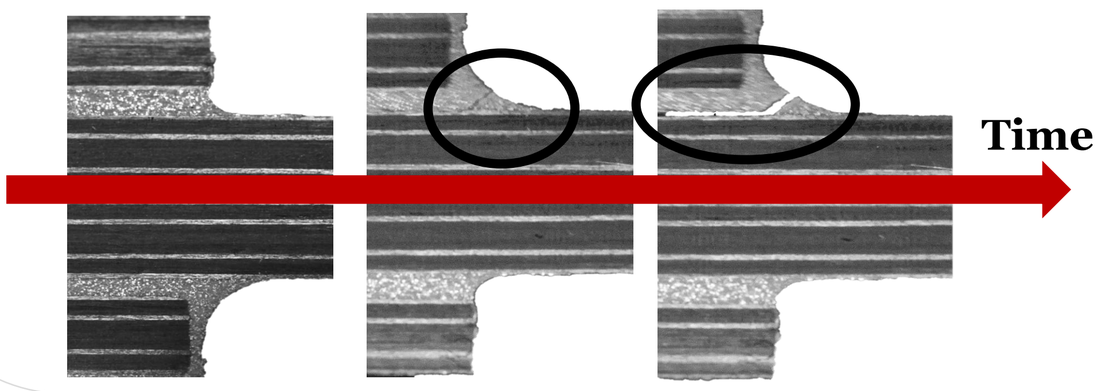
Failure Mechanisms

- **12mm Overlap Length –** Patches of adhesive on fracture surface as failure was controlled by adhesive strength



- **36mm Overlap Length –** 0° plies visible on both fracture surfaces and failure was fracture dominated





- **High Speed Camera** used to capture failure mechanism for **36mm overlap length**
- Captured crack migration into composite surface ply
- Crack **initiated** at **adhesive fillet** at an angle
- This was followed by **propagation** of the **crack** into the **0° ply at the skin**
- Fracture was sudden

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